PUBLIC WORKS

CITY COUNTY STATE

DRIVING A CHICAGO WATERWORKS TUNNEL

Chicago is driving a tunnel more than five miles long and 11 feet 4 inches wide by 12 feet high for bringing water to a new pumping station. The illustration at the right shows a view at the foot of the 61st street shaft, while that below is a view of the tunnel taken from that point. The work is described in this issue.

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol 52 JANUARY 7, 1922 No. 1

Western Avenue Tunnel Extension

Excavated in rock 622.6 linear feet daily per heading. Details of blasting, mucking, timbering and alignment. Mechanical equipment and concrete lining.

The Western Avenue tunnel extension, Chicago, to afford a water supply for the new William Hale Thompson pumping station, is 11 feet 4 inches wide and 12 feet high inside and is being driven about 33,000 feet through solid limestone rock from a gate shaft at State street and West 73d st. to another gate shaft at the intersection of Western ave., and thence on Western av. to 45th street. It parallels the center lines of the streets on tangents, making a right angle at the Western ave. gate shaft and having the invert about 140 to 155 feet below the surface of the ground.

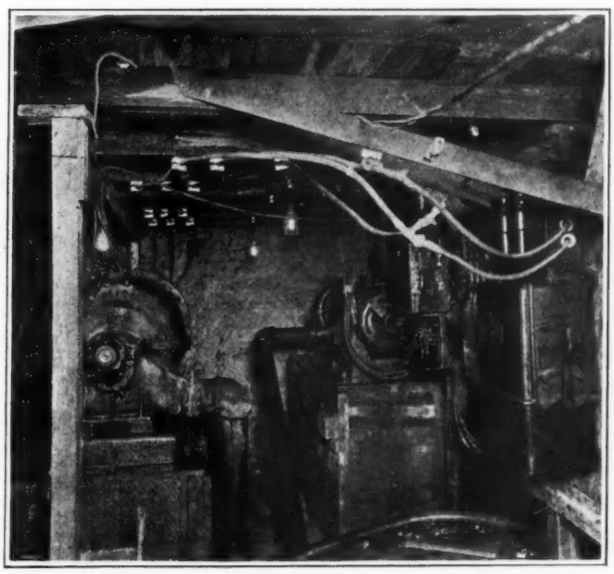
It has a cross-sectional area of 118.78 square feet and a perimeter of 40.16 feet, and involves a rock excavation of 6.0 cubic yards and a concrete lining of 1.6 cubic yards per linear foot. It has a capacity of 800,000,000 gallons per 24 hours at a velocity of 3.92 feet per second.

The total average force employed in the four headings is about 400 men.

The tunnel is being excavated simultaneously at four headings, two driven from the foot of a construction shaft at Wood street 4,000 feet from the Western ave. gate shaft and two from the foot of the 61st street shaft about 8,000 feet from the Western ave. gate shaft.

The work was commenced by sinking, in 1919, of the two construction shafts described in *Public Works,* page 477. The excavation was commenced in the first heading, driven in the foot of the Wood street shaft, in May 1920, and on the fourth heading in June 1920 and the excavation was 33 per cent completed November 15, 1921.

It is estimated that the two construction shafts, two gate shafts, tunnel excavation and pumps will require a total amount of 200,000 yards of excavation and 53,000 yards of concrete, will cost about $4,000,000 when completed and that the tunnel will be ready for service in November 1923. The work is being done on force account by the city of Chicago under Alexander Murdock, City engineer and Myron B. Reynolds, designing engineer, and the Waterworks Department, James J. Versluis, constructon engineer, and E. P. Scott and G. S. Samuels, resident engineers.



PUMP ROOM AT FOOT OF 61st STREET SHAFT

MINING AND MUCKING

The work is executed under atmospheric pressure and is carried on continuously with two 8-hour shifts in each of the four headings. The miners enter three hours after the muckers in each heading and for both headings, a total of 44 linear feet daily with a maximum record of 46 feet is secured.

The work is done by the regular top heading and single bench method, the full width top heading being about 7 feet high in the center and being drilled with from 23 to 30 holes 14 feet long arranged approximately as indicated in the diagram. The holes are driven in an average of 2½ to 3 hours actual drilling time, using bits from 2⅝ inches to 1¾ inches in diameter with a 1¼ inch steel.

The 10 "cut holes" are each charged with 15 sticks of 60% dynamite making a total of about 125-lbs. Nine or ten sticks are used in each of the No. 2 or "helper holes" and nine in each of the "rim holes" 4, 5, and 6, making a total of 400 to 450 pounds, explosive for the entire heading. The sticks weigh about 1 pound each and about eight sticks are generally used for charging each of the bench holes.

In the headings the blasts are fired with direct exploders for the cut holes, first delay for the helpers, second delay for the breakdown holes After examining the results of the blasts in the cut holes and noting the character of the rock exposed, the rim holes are loaded and fired direct or delaying as may be required. The bench holes are fired with the cut holes, direct for the front row and delay for the back rows. About 38 pounds of explosive is required for a linear foot of tunnel and produces from 10 to 11 yards of loose muck.

The drilling is done by four Ingersoll-Rand water liner machines mounted on two columns in the heading and by two Ingersoll-Rand water liners or piston drills mounted on tripods for the bench work. The rock is in irregular strata, separated by many clay seams from 1 to 2 inches thick, and is usually about 18 to 36 inches thick. The powder sometimes blows out in the seams requiring the holes to be recharged or redrilled.

MUCKING

For convenience in shovelling the rock is shot down on sets of three 3 by 12-foot floor plates ¼ inch thick, laid side by side a few feet in the rear of the bench. It is loaded by hand into 1-yard 24-inch gage side-dump cars, hauled in pairs by mules to the shafts and hoisted and delivered to the dumps in 6-car trains as described in the previous article.

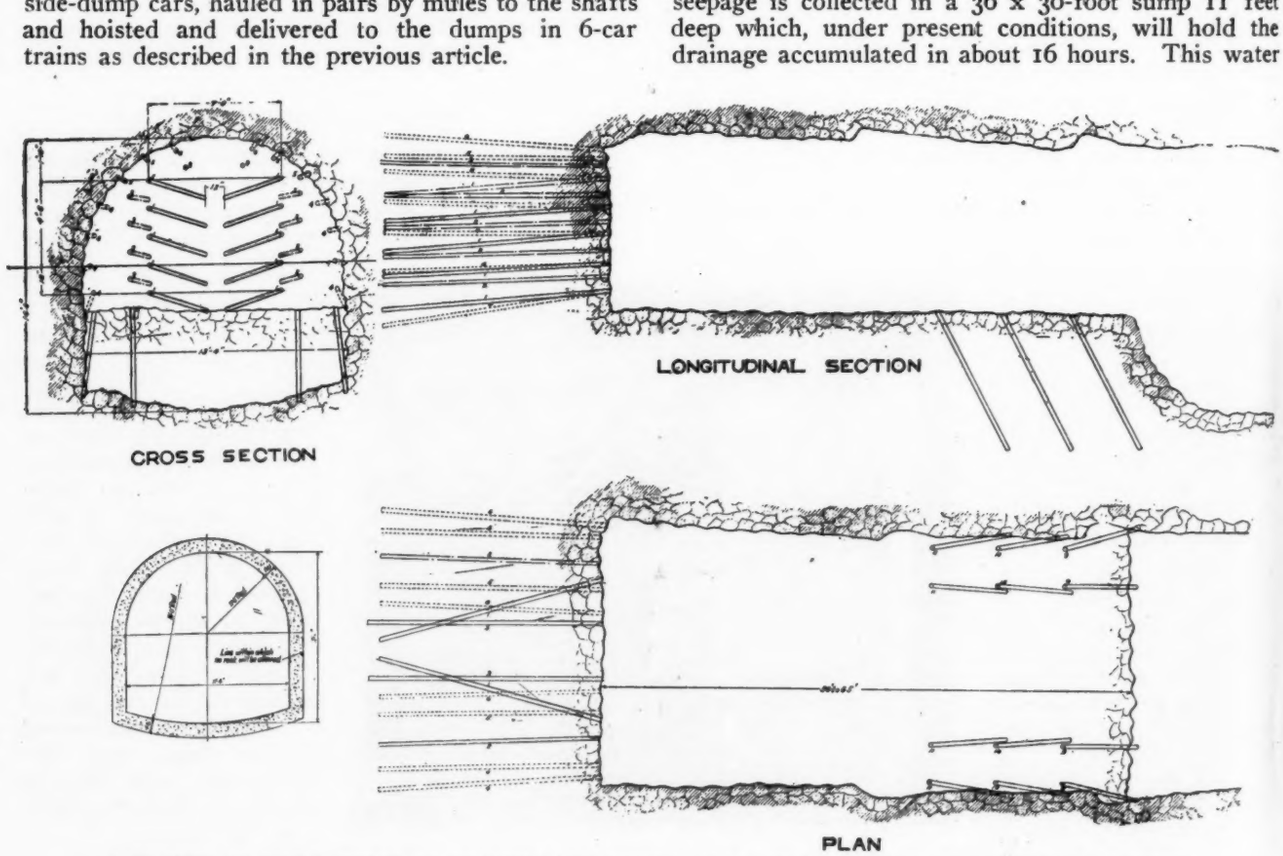
The rock from the headings is delivered by wheelbarrows on a platform extending about 20 or 30 feet beyond the face of the bench and supported on horizontal cross pieces about 6 feet apart and 7 feet above the tunnel floor, each consisting of telescopic 3-inch and 4-inch heavy pipes securely wedged in pick holes made in the side walls just below the spring line. At the rear end the wheeling platform is forked in a Y-shape so that the wheelbarrows can dump into cars on either of the two tracks below.

Generally the rock is sound enough to be safe without timbering, but in a few places where it is loose and treacherous the roof has been wedged up on 5-segment arch timbers, supported on longitudinal sills carried along the side walls on pairs of steel bars drilled into the rock at the spring line and thus obviating the necessity of vertical posts that would encroach on the narrow working space that barely suffices for the two service tracks.

The alignment of the tunnel is made from drill holes in the roof filled with wooden plugs in which are driven horse shoe nails with their heads drilled to receive the line of a plumb bob that is suspended in a three sided box painted white inside and illuminated by an electric lamp. The roof plugs are spaced about 75 feet apart and are checked from time to time with transit shots 1,000 feet long. Grade plugs are set in the side walls on the spring line at intervals of about 75 feet.

MECHANICAL EQUIPMENT

The tunnel slopes down on a grade of 0.2 per cent in both directions to the foot of each shaft where the seepage is collected in a 36 x 30-foot sump 11 feet deep which, under present conditions, will hold the drainage accumulated in about 16 hours. This water



LOCATION OF DRILL HOLES IN HEADING AND BENCH, ALSO CROSS SECTION OF COMPLETED TUNNEL

is pumped out at the Wood St. shaft by one 300-gallon Yeomans Bros. Co. pump, one 1200-gallon Lea-Courtney pump and one 8x10-inch Deane plunger pump. The large pump has a capacity sufficient to empty the sump in 40 minutes. Usually one pump only is run at a time and the others are held in reserve.

At the 61st st. shaft there are two 900-gallon Lea-Courtney motordriven centrifugal pumps with a lift of 185 feet. They are located in a pump chamber quarried out of the rock at the foot of the shaft. At each shaft there are installed two General Electric air compressors each with a capacity of 5,000 cubic feet of air per minute, which is delivered through a 16-inch pipe in the shaft and an 18-inch main in the tunnel. High-pressure air for operating the drills is produced by four Ingersoll-Rand motor-driven two-stage compressors with a capacity of 600 cubic feet per minute, each of them delivering to a pair of 6-inch pipes. Water pressure is delivered to the heading through a 3-inch riser line in each shaft.

The equipment at the Wood street shaft is similar to that above enumerated and the air for ventilation is delivered to the headings through 16-inch risers and two 18-inch tunnel mains made of 14-gage steel in 20 foot lengths with special gasketed flange joints. The general air supply for the tunnel ventilation is compressed to about 1½ pounds at the machine.

CONCRETE

The construction of the concrete lining has not yet been commenced, but it is planned to mix and place it in ⅓-yard batches, conveyed by pneumatic pressure with the same plant that was used for lining the Wilson avenue tunnel 12 feet in diameter and 8 miles long.

The lining will require about 53,000 yards of concrete, which will be made with stone provided by the tunnel excavation which will be utilized approximately as fast as delivered by the muckers without ever being carried to the surface of the ground. The method, operations, and plant for the tunnel lining will be the same as those adopted with the notable success and economy for lining the similar 8-mile Wilson avenue waterworks tunnel in Chicago that was completed by the waterworks department 5 years ago. As the lining constructed by this method can be completed about twice as fast as the heading excavation, operations will not be commenced until a later time, when the tunnel will have been about one-half excavated, as the rock then remaining to be mucked will more than suffice for the required amount of concrete and the lining can go on uninterruptedly to a completion about simultaneous with the finishing of the excavation.

STEEL FORMS FOR LINING TUNNEL WITH CONCRETE CONVEYED BY PNEUMATIC PRESSURE

The plant that was used in the Wilson avenue tunnel consists of four complete concreting outfits, two of which will be installed at the foot of each construction shaft and will advance toward their respective headings. In each outfit a screening and conveying apparatus, hoisting engine, pneumatic concrete mixer, compressed air tanks and concrete delivery pipe are installed on two detachably connected, long and narrow structural steel travelers, moving on one of the 24-inch gage service tracks on the tunnel floor and affording clearance alongside for the cars passing back and forth between the shaft and the heading.

FANS AND HOIST IN SHAFT HOUSE AT 61st STREET

The operations are identical for each of the four duplicate installations. Broken rock from the headings will be delivered in 1-yard side-dump cars that are hauled by an electrically driven hoisting engine to the top of a movable steel incline 15 ft. 3 in. long and thence over an elevated bridge to the rear of a screen traveller which has a 13-foot wheel base and a platform set 9 feet above the tunnel floor on which there is mounted a hoisting engine and an electric motor that drives a belt conveyor running to the top of a forward projecting cantilever arm 12 feet long.

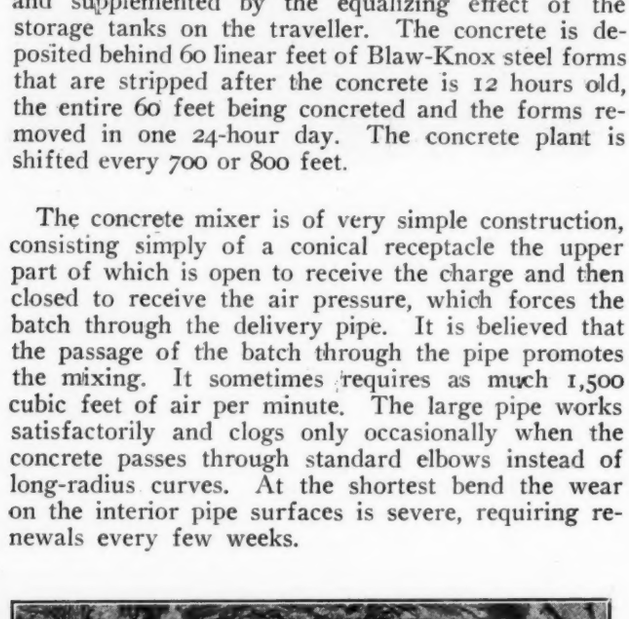
The stone is discharged over a perforated steel plate screen through which all pieces less than 4 inches in diameter drop to an inclined conveyor and are continuously discharged at a height of 7 feet above the tunnel floor into a hopper above the pneumatic mixer. The hopper 3 feet 6 inches long is mounted with the

mixer and the air receivers, on a structural steel traveler with an 18-foot wheel base.

The hoisting engine is operated by a 10-h. p. electric motor and the belt conveyor is operated by a 3 h. p. motor driven at a speed of about 150 feet per minute.

The pneumatic mixer delivers into an 8-inch horizontal discharge pipe carried just above the tunnel floor on the center line of the service track. Through it ⅓-yard batches of concrete are delivered to any distance up to 1200 feet or more, and at variable elevations up to the crown of the arch. The mixer and conveyor are both operated by air under 80-lbs. pressure received from the regular tunnel supply main, and supplemented by the equalizing effect of the storage tanks on the traveller. The concrete is deposited behind 60 linear feet of Blaw-Knox steel forms that are stripped after the concrete is 12 hours old, the entire 60 feet being concreted and the forms removed in one 24-hour day. The concrete plant is shifted every 700 or 800 feet.

The concrete mixer is of very simple construction, consisting simply of a conical receptacle the upper part of which is open to receive the charge and then closed to receive the air pressure, which forces the batch through the delivery pipe. It is believed that the passage of the batch through the pipe promotes the mixing. It sometimes requires as much 1,500 cubic feet of air per minute. The large pipe works satisfactorily and clogs only occasionally when the concrete passes through standard elbows instead of long-radius curves. At the shortest bend the wear on the interior pipe surfaces is severe, requiring renewals every few weeks.



FORWARD END OF PNEUMATIC CONCRETING PLANT

Importance of Restricting Motor Truck Loads

After having spent $600,000 in one year for the repairs of roads injured by excessive loads on motor trucks the State of Maryland in 1920 amended the motor vehicle law, limiting gross loads to 20,000 pounds, and the maximum load per inch width of tire to 650 pounds, maximum width of truck to 90 inches, maximum rated carrying capacity to 5 tons, and maximum speed per hour to a sliding scale varying from 25 miles for a 2-ton gross load to 12 miles for a gross load exceeding 6 tons. The truck load is also limited to its rated capacity.

The load clauses of the law are enforced by officials operating permanent road scale between Baltimore and Philadelphia and another on the Baltimore-Washington Boulevard and by an inspection party consisting of two inspectors, two laborers, a uniformed policeman and equipped with four loadmotors (portable jacks) in a light automobile that travel about on the different state roads, stopping and weighing any trucks that appear to exceed the load limit. A loadmeter placed at each wheel lifts the truck entirely free of the ground and indicates the exact gross load while running the tires over a white paper. Carbon paper and smooth steel plate gives an accurate imprint of the bearing width of the fire.

In the first week of their application, in September 1920, 60 trucks were fined from $10 to $100 each for overloading, in the second week on different routes 70 trucks were caught after which, inspectors changing their positions irregularly discouraged over loading so much that in the sixth week only one truck was found to be overloaded and loads of more than 10 tons have now practically disappeared.

At first the fines imposed did not deter some shippers from continually overloading their trucks when they were allowed to carry the excess load to the nearest railroad station and reship it, but when they were compelled to discharge the excess by the roadside and send another truck out to pick it up the practice was soon abandoned.

There are 1700 miles of road in the Maryland State Highway system and since the prevention of overloads the chief engineer of the State Highway System reports that there has not been a single road failure and he estimates that the extra cost to shippers of reducing heavy unit loads of 5-ton trucks would not have been more than $15,000 if applied to the loads that had done $600,000 damage to the Maryland system. It had previously been found that a $500 yearly registration fee did not keep 7-ton trucks from the highways and the present policy is not to deny the highways to motor trucks, but rather to restrict the latter in the interest of economical highway transport so as to give the entire state the highest operating value for the highway system.

Wood-Stave Water Pipe

A summary of the results obtained by its use in U. S. Reclamation projects during the past twenty years.. Comparison of fir and redwood, buried and above ground.

In November 1920 the chief engineer of the U. S. Reclamation Service sent a questionnaire to managers of all the reclamation projects asking for information regarding wood-stave pipe installations, this information including such data as the location of the pipe, the diameter and length, whether built of redwood or fir, whether machine banded or continuous, the maximum head on the pipe, whether it was buried or above ground, the date when it was installed, and its present condition.

Data were supplied by eighteen separate projects covering 196 separate installations. As eighteen men contributed the information, their use of the general terms descriptive of the condition of the pipe such as "perfect," "no good," etc., varied as the personal equation varied. In tabulating the answers the general office used its best intelligence to classify these under the descriptive terms used by it of perfect, excellent, very good, good, fair, poor, very poor, bad, almost useless and no good. After tabulating the data under these classifications, these terms were further grouped under two headings, "fair or better" and "poor or worse." It is thought that all pipe described by the former is still giving satisfactory service, while that given under the latter head was not giving satisfactory service at the time of the examination although it may have been doing so shortly before that time.

From a study of the data a few general conclusions were drawn, which are published in the December issue of the "Reclamation Record" as follows:

1. One condition which, while not universal, is in general quite typical of the operation of pipe lines in the Reclamation Service is that they are full of water only part of the time. This condition is generally recognized to be conducive to the early decay and destruction of wood pipe.

2. Many installations of wood pipe in the Reclamation Service are in soils that are more or less heavily impregnated with alkali and carry alkali-laden water. This contact with alkali appears to have resulted in several instances in the early destruction of the steel bands and wire winding of the pipe.

3. There are 65 installations reported as being made between the years of 1916 and 1920, all but three or 95.4 per cent of which are reported as in fair or better condition. The three installations reported in poor or worse condition were made in 1916 and 1917 and were of untreated fir staves placed in moist earth and kept full of water during the irrigation season only. They were in sizes of 10 to 12 inches and are under maximum hydrostatic heads of 10 and 15 feet.

4. Of the 59 installations made during the period of 1911 to 1915, inclusive, 50, or 84.7 per cent, are reported as in fair or better condition. Of the 9 in this group reported as being in poor or worse condition, 2 are of untreated fir in moist earth, full during the irrigation season only, 1 is redwood buried in alkali soil that has destroyed the winding, 2 are untreated continuous fir laid in gravelly soil, and 4 no information is at hand as to nature of soil or continuity of service.

5. Of the 71 installations made during the period of 1910 and earlier, 54, or 76 per cent, are reported in fair or better condition. There are 3 installations made in 1901 and 1 in 1904 which are all the installations reported as being made prior to 1905. All of these are reported to be in fair condition, although all are reported as having been moved and relaid.

6. Of the 29 installations of all periods reported in poor or worse condition, 18 describe no circumstance surrounding their construction or operation that might be taken as the reason for their unsatisfactory state. The remaining 11 installations record reasons such as "full during irrigation season only," "installed in gravelly soil," etc., that might be considered as causes for their failure, but which are also reported as existing in connection with installations giving satisfactory service. So the evidence is not conclusive as to why these installations have failed.

7. In stating the probable life of wood-stave pipe installed and operated under average conditions existing on the projects of the Reclamation Service, as indicated by these data, it is probably safe to say that there is an even chance or better that with some maintenance an installation will give 15 years of satisfactory service and that if unfavorable conditions are avoided there is a reasonable certainty that this satisfactory life will be not less than 10 years.

8. Reported conditions that apparently have tended to shorten the useful life of the pipe lines may be stated as follows:

(*a*) Intermittent service, pipes full of water during the irrigation season and empty during the non-irrigating season.

(*b*) Installations made in gravelly or open soils.

(*c*) Installations made in alkali soils resulting in destruction of the bands and wire winding.

(*d*) Installations using separate wooden collars at joints. These collars tend to rot out while the pipe proper remains in good condition owing evidently to the fact that the collars are not so thoroughly saturated in service as the walls of the pipe.

(*e*) Installations under low hydrostatic heads—say less than 15 feet—which are not sufficient properly to saturate the wood.

The tabulated data show that, considering all installations of all ages, about one-third of the wire-wound fir staves that had been buried and about 2% of such pipe that was laid above ground, were now under the "poor or worse" class. Of the wire-wound redwood staves, all of which were buried, only about 1 1-3% were in the "poor or worse" class. Of the continuous fir staves which were buried, about 25% were under the "poor or worse" class, while of those that were above ground about 22% were in that class. The continuous redwood pipe had not been laid upon reclamation projects prior to 1916, and of the 450 feet buried and the 10,608 feet laid above ground all was still in the "fair or better" class.

Winter Protection for Contractors' Machinery

Road officials should make every effort to get all road equipment which is not in use under shelter for the winter. More damage is ordinarily done to graders, tractors and other road machinery by standing out through the winter entirely unprotected than by the actual usage during the road building season. Not only should all machinery and equipment be put under cover or protected from the sun, rain and snow but every piece should be thoroughly oiled and greased on all uncovered metal parts. The winter time should be the time for making all general repairs, overhauling the engines, securing of all new parts needed and laying in whatever stock or repair parts experience shows to be necessary for the county season's work. A few gallons of paint properly

applied means hundreds of dollars saved during the year. The winter time is the proper time to do the painting. The work on the repair of the county machinery should provide employment for the foremen and best men in the county crews, so that the experienced men can be retained and the county not be put to the expense of training up new foremen and entirely new crews when the season opens. This work can only be done with the machinery and equipment under cover.
—*Iowa State Highway Commission Service Bulletin.*

Sensitive Detection of Suspended Matter

By John R. Baylis*

A device for detecting turbidity and suspended particles in the effluents of filtration plant, used especially to detect breaks in the filter mat.

In operating the Montebello rapid sand filters in Baltimore, the engineers have realized for several years that it was desirable to detect turbidity and coagulated particles in quantities more minute than the ordinary laboratory methods made possible, the chief object being to detect breaks by small particles of floc passing through in suspension or by a cloudy appearance due to unclarified water passing through the break in the filter. It was suspected that in some cases the settlement of matter in the mains which had passed through breaks in the filter mat have been incorrectly attributed by the operators to secondary chemical reactions. At any rate, it is believed that floc passing the filters will settle and accumulate in mains and reservors and be occasionally picked up by temporarily increased velocities and make turbid the water delivered to the consumers.

About two years ago efforts were made at the Montebello filters to design a device that would detect immediately any turbidity or presence of coagulated particles, this device to be applied to the effluent from each filter. The first plan tried was to pass a small portion of the effluent water through a 3-inch pipe set vertically with a light at the bottom, the water passing vertically upward through 5 feet of pipe and discharging at the top. This was not a success, chiefly because it was not possible to bring the eye near enough to the slight suspended particles to be within ordinary reading distance 12 to 18 inches. Moreover, the light illuminated the bottom of the particles instead of the tops which were visible.

The illumination of dust particles in a dark room by a ray of sunlight suggested the passing of a ray of light through the water approximately at right angles to the line of sight of the observer, and provision for bringing the eye to within 12 to 18 inches of the column of water under observation.

A number of different ideas were tried out and a device was finally perfected which is now being used with success. In this device a spherical flask filled with water gives a magnification of approximately two diameters on the side opposite the observer, so if such a flask is used it must be placed where the opposite side is the proper distance from the eyes. The best condition for the light is at such an angle that none of the rays will strike the eyes or any surface that will reflect the rays, except the particles in suspension. This latter condition can only be approximated, but sufficiently so for our use.

It was thought best to use spherical flasks for the present, due largely to their cheapness. The best position of the light was found to be at an angle of from 90 degrees to 120 degrees to the line of sight. The device as finally constructed and put in operation consists of a 3-liter round-bottom pirex flask, with two small copper tubes about 3-16 of an inch inside diameter entering the flask through a rubber stopper. The inlet tube extends nearly to the bottom of the flask while the outlet tube stops just below the bottom of the stopper. The flask is set in one side of a wooden box, on the other side of which is a 200 watt lamp. Between the flask and the lamp is a partition and in this is a hole about 4 inches in diameter which allows the light from the lamp to pass into the flask at an angle of between 90 degrees and 120 degrees with the line of sight of the observer. In one side of the box is an observation hole about 3 inches in diameter.

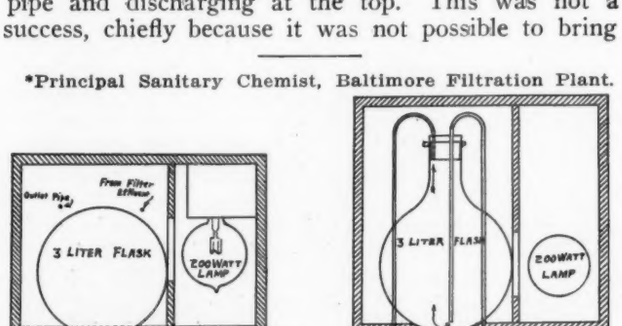
The devices (now preferably mounted in a metal rather than a wooden box) are mounted on the marble operating tables, and a switch on the side of the table enables the operator to turn the light on or off.

The copper inlet tube is extended about 25 feet to the point where it receives the filter effluent before this passes through the filter rate controller. Water is drawn through the flask by siphon action, the effluent pipe extending about 2 feet below the lowest level likely to occur in the filter effluent. At the Montebello filters the flow through the flask is at the rate of about 100 gallons in 24 hours. Siphoning can be started by drawing the air from the outlet pipe by either the mouth or a vacuum pump. It is necessary that the outlet tube be sufficienly small to produce a velocity that will carry out any air bubbles present in the flask.

With this device it is possible to detect the presence of particles that would not cause a turbidity of 0.01. A single particle of floc in a liter of water can be seen readily, the light conditions and magnifyng effect of the side of the flask making visible smaller ones than could be deteted under ordinary conditions.

The device of course does not give any quantitative

*Principal Sanitary Chemist, Baltimore Filtration Plant.



PLAN SECTIONAL ELEVATION
APPLIANCE FOR DETECTING MINUTE SUSPENDED MATTER

results, although a series of comparisons with samples of determined turbidities would probably enable an observer to estimate turbiditity approximately; but it does permit the detection of particles that would hardly be discovered by analytical methods, and makes the discovery immediately so that prompt action can be taken to remedy the condition of the filter.

(Under date of January 2nd Mr. Baylis writes: "This is the time of year we need the turbidity detector most and it has proven very useful. We are washing filters with loss of head ranging from 2½ to 8 feet. It will open the eyes of many filter operators and will stop considerable talk about after-precipitation or incomplete chemical reactions until after filtration.")

Military Equipment for Road Building.

The War Department has turned over to the Department of Agriculture $150,000,000 worth of surplus war materials to be distributed through the Bureau of Public Roads for road building purposes. The largest items were for New York $5,509,520, Illinois $5,462,400, Texas $7,101,240 and Pennsylvania $4,384,600; only seven of the states receiving each less than one million dollars worth of road equipment.

Taxes on Motor Vehicles

It is reported that during 1921 federal, state and municipal taxes on motor vehicles amounted to a total of $316,720,000 which is equivalent to an average of about $34 per car.

Prevention of Misuse of Sewers

Failure of municipal official to properly control establishment and use of connections results in impairment of efficiency of sewerage and sewage treatment systems and generally unsatisfactorily results.

By W. H. Dittoe*

The purpose of this discussion is to call attention to the abuse of sewerage and sewage disposal systems resulting from failure of municipal officials to control properly the establishment and use of connections to sewers. Sanitary engineers generally have deplored this condition of affairs and as a class are in agreement that better control should be provided. However, sanitary engineers have been prone to leave entirely to municipal officials the solution of this problem and with few exceptions have failed to recognize that it is essentially their duty to take the lead in establishing proper control. This discussion will attempt to show that sanitary engineers must not only recognize the importance of preventing abuse of sewerage and sewage disposal systems, but must actually undertake the problem of prevention if the expected efficiency of such improvements is to be realized.

One of the most important factors reducing the efficiency and value of systems of sewerage and sewage disposal is the misuse of sewers. Sufficient emphasis has not been placed upon this subject and rarely is it found that a municipality enforces a strict policy regarding the use of sewers. Considerable effort is expended by engineers in designing sewerage systems and sewage disposal works and as a basis for such design the volume and character of the sewage flow must be known or estimated. Therefore, if these factors are disturbed appreciably the improvements will not be used under the conditions for which they were designed. The result will be a shorter life of the system as a whole, impairment of its efficiency and generally unsatisfactory results. The misuse of sewers is also an important fault affecting the successful operation of sewage disposal works and hence the problem of prevention of stream pollution. It is useless to design sewerage improvements upon an assumption that certain maximum rates of flow will occur and that the sewage will be of a certain character unless the construction of such works is followed by the enforcement of a definite policy which will insure against exceeding such rates or changing such character.

Sewers are designed for definite purposes and when used for other purposes may be said to be misused. Storm drains are misused if they received sewage, industrial wastes, or other waste of objectionable character. Combined sewers are properly used for the removal of practically all classes of liquid wastes but are misused if they receive industrial wastes affecting the sewerage system or process of sewage treatment. Sanitary sewers, as the name implies, are for sanitary purposes only and are misused if they receive drainage from the surface and roofs, subsoil drainage such as may be admitted by building foundation drains and through open or leaky joints, and industrial wastes of a character to affect the sewerage system or treatment process.

The effect of the misuse of sewers is frequently quite serious. Sewage discharged into storm sewers causes nuisances at outlets and offensive odors through street inlets. If such practice is permitted, the benefits to be expected from a separate sewerage system are not realized. The admission of surface and subsoil drainage to sanitary sewers overtaxes the sewerage system, resulting in cellar flooding and damage to sewers, and overburdens pumping equipment and sewage treatment works necessitating by-

*Paper before Symposium on Steam Pollution and Sewage Disposal arranged by the Am. Soc. of Civil Engineers.
*Chief Engineer, Ohio State Department of Health.

passing of the flow, impairing the efficiency of the plant and frequently causing rapid deterioration. Industrial wastes discharged into sewers often cause sewer clogging or may actually destroy the sewers if the wastes have solvent properties. Many industrial wastes also interfere seriously with the efficiency of sewage treatment plants.

Of the more troublesome industrial wastes may be mentioned: Wastes from tanneries and glue factories containing hair and lime; wastes from textile industries containing cloth, fibrous material and objectionable compounds in solution; wastes from canning factories containing vegetable particles; wastes from stockyards containing manure; wastes from packing plants containing animal offal; gasoline wastes from garages; acid wastes from metal industries; wastes from milk industries and gashouse wastes. Such wastes should be treated properly prior to their discharge into the public sewers or should be excluded entirely.

It seems apparent that the evils resulting from misuse of sewers are of sufficient importance to warrant a real effort to prevent it. It has been accepted by many engineers that the misuse of sewers, particularly sanitary sewers to carry storm water, is inevitable and cannot be prevented, and this conclusion has produced a strong argument for the selection of the combined system. It is true that the combined system can rarely be misused and that from this standpoint it is preferable. However, it does not appear sound to conclude that it is impracticable or impossible to secure proper use of separate systems. In fact separate systems now existing will continue in use and new systems will be built; therefore, engineers and city officials cannot avoid the responsibility for securing their proper use. The industrial waste menace is present and must be controlled regardless of the kind of sewer system used.

It is obvious that the proper use of sewers cannot be secured without strict enforcement of ordinances and regulations by the proper municipal officials. The sewer contractor and the property owner cannot be expected to realize the importance of using sewers properly and for the purposes for which they were designed to function, and therefore they must be controlled in order that the public may not suffer from their mistakes. Ordinarily, municipal officials themselves do not appreciate the necessity of protecting sewers and sewage treatment plants from abuse, and therefore are not in position to initiate suitable regulations. It seems apparent that it becomes the duty of sanitary engineers to dictate such regulations and to see that they are adopted. This function of the engineer is as important as the design and supervision of construction of the improvement and if it is not performed it may truly be said that the work of the engineer has not been complete. Ordinarily, the engineer who has designed and supervised the construction of a sewerage system and a sewage treatment plant furnishes definite instructions in regard to the operation and maintenance of the system and he should likewise furnish a definite program for preventing misuse which may defeat the purpose of the improvement.

Many municipalities have satisfactory ordinances and regulations but fail to enforce them. Such ordinances usually require permits for connections to the sewers and provide for inspection of the connection by a representative of the municipality after the contractor has completed the construction work and before the trench is filled. Theoretically this control should be sufficient but too frequently the results are far from satisfactory. In many instances the construction work is faulty, joints are made imperfectly and so admit ground water to the sewer, the inspection is neglected or performed carelessly, improper wastes are admitted, and no proper record of the connection is maintained. When this system of control is started improperly it is very difficult to correct it and make it efficient and usually the conditions become worse rather than better until the sewer system is generally abused.

It seems necessary that municipalities provide a more immediate and direct control of the use of sewers if sewerage systems are to be managed and maintained as they should be. The most logical and effective method of accomplishing this is the construction by the municipality of all connections to the public sewers from the building to the street sewer and the continuation of municipal control over such connections after they are constructed. The sewer department would organize its construction gangs for this work or would enter into annual contracts with responsible contractors, and the property owner would pay to the city the cost of construction, inspection and recording.

When local treatment of industrial wastes is necessary to protect the sewerage system or sewage disposal works, such treatment would be provided by the industry and the effluent received into the sewer system under proper control. The connection could be equipped with an inspection hole to permit subsequent examination by the sewer department of wastes discharged through it and discharge of prohibited wastes could thus be detected. It is believed that this method of installation would insure better construction of the connection at lower cost, would largely prevent the misuse of sewers, and would assist in securing efficient operation of sewage treatment processes. Incidentally it would probably arouse a more lively interest on the part of the city officials in the management and maintenance of the sewerage systems and would likewise remind the public that the system is an important feature of the community development and must be controlled in a business like manner if its value is to be realized.

Illness from Sewer Gas.

In England, as in this country, sanitarians are generally agreed that sewer gas is not an immediate cause of disease, but in spite of evidence to the effect by English specialists, an English court has awarded damages against the city of Liverpool and in favor of a plaintiff who stated that he and his family of four children were made very ill by sewer gas which was caused by the neglect of the city workmen in leaving cleaning rods in the sewer near their house, as result of which the sewer was blocked. Altogether the court awarded this family over $2,0 damages with costs.

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The First Annual Report

For several years past we have noted in these columns the first annual report to reach this office. Naturally the earliest reports are those which are sent in typewritten form rather than the printed reports. We also find that reports of individual departments can always be gotten out more promptly than publications containing the combined reports of all departments, since there seem always to be one or two departments in each city whose dilatoriness holds back the publication of such combined reports.

This year we received a report for the year 1921 on January 3rd, the first day of the new year in which mail was delivered. This report was that of W. P. Cottingham, city engineer of Gary, Ind., for the past four or five years and re-appointed by the incoming administration.

This report includes tables showing the street and alley work done during the year and the one sewer contract awarded during the year, together with a summary of this work. These show that about 124,000 square yards of reinforced concrete and sheet asphalt pavements and 5,116 square yards of sidewalks were laid at a total cost of $503,147; and 22,676 square yards of concrete alleys at a cost of $77,514, and sewers to the extent of $10,590. During the four years of the present administration the improvements carried out by the engineering department have totaled nearly $2,000,000.

On special assessment improvements, the engineering and inspection charges are included and are returned to the general fund when the assessment has been collected. During 1921 the engineering and improvements carried out by the engineering departconcrete streets, 2.53% on asphalt streets, 2.87% on concrete alleys and 2.42% on sidewalks.

Co-Ordinating State Construction

For many years there have been perennial efforts, more or less perfunctory, to unify federal construction operations. National construction work has been distributed through almost all of the principal departments of government so that its closely allied operations are conducted simultaneously in the War, Treasury, Agricultural and many other departments resulting in a conflict of authority and standards, in opposing plans, in unnecessary multiplication of organization and equipment and in inevitable waste delay, uncertainty and other kinds of inefficiency, that it is believed could be greatly diminished by the establishment of a department of Public Works to handle all construction matters.

Similar conditions prevail in some of the states and in New York State public construction is at present distributed through the departments of Public Work, State Engineering, Highways, Public Buildings and the office of the State Architect. These departments have thousands of employees and execute hundreds of millions of dollars worth of work, some of it to considerable disadvantage, that if corrected, might well effect the reduction of ten million dollars that Governor Miller wishes to make in next year's expenditures.

The conflict of authority, duplication of officials and employees, divergence of plans, interference of operations, uncertainty of standards, jealousy, delay and waste are inevitable, especially in politically effected work where the same undertakings may reach into several overlapping departments with varying standards, traditions and habits.

It is obvious that great advantages would be obtained by reorganizing all of the present construction departments under one which should be that of the State Engineer, co-ordinating all operations and interests and maintaining separate bureaus for special classes of work, such as public buildings, highways, conservation, river and harbor work and the like under uniform direction that would eliminate many duplications and all conflicting offices and operations and establish definite responsibilities and combine resources that will make for quicker, better and cheaper results, which if they secured only the very conservative saving of 10 percent in present costs and time, would soon amount to many million dollars for New York State.

Refuse Disposal and Street Work in Newport

A contract for collecting and disposing of the refuse of the city of Newport, R. I., held by Moses David, expired on January 4th of last year and, following an advertisement for bids for this work, the contract was let to C. V. Strona to make collections by auto truck for $44.85 a day. After about a month's trial Mr. Strona cancelled his contract and the aldermen then awarded a contract to David & Dannin at $64.75 a day. This arrangement continued until April 17th, when a contract was made with this firm for three years at the rate of $19,250 a year, providing the representative council appropriated each January a sufficient amount to cover the contract. The appropriation for collection and disposal for last year was $20,400, of which only $19,351 was spent.

The city has several dumping places along low land and two men are employed constantly on the dumps to level off the material delivered. Last year the total expenditure for this labor was $2,606.

The city kept a record of the amount of material collected and the average per day for each of the several months varied from a minimum of 43 tons per day in March to a maximum of 71½ in December, except for May, which clean-up week brought up to an average of 93 tons. The total amount collected during the year was 17,196 tons. (The population of Newport is a little over 30,000, this giving the average refuse per capita as about 1,100 pounds for the year.)

In cleaning streets, 4 foremen and 29 men with 5 carts were employed on macadam streets and all others except those with durable pavements, while on the latter 11 men and 3 carts were employed throughout the year except when the streets were covered with snow. There were 2,484 miles of cleaning of streets with durable pavements, containing 41,581,000 square yards, and these were cleaned at a cost of $22,189, or an average of about 55 cents a thousand square yards. When the costs are given by streets, however, it is found that the cost per 1,000 square yards for the different streets varies from a minimum of 22 cents to a maximum of $1.14.

In sprinkling the streets, Street Commissioner John F. Sullivan used both horse-drawn sprinkling carts and a motor truck sprinkler, the latter beginning operations on April 12th and continuing in use until November 6th, while the horse-drawn carts were retired on September 6th because the appropriation was exhausted. During the 7 months that the motor truck sprinkler was in operation it used 713,000 gallons of salt sea water in sprinkling 566 miles or 8,709,000 square yards of street, and applied 275,000 gallons of fresh water on 199 miles or 3,184,000 square yards. The total cost of this work was $6,953. The motor truck sprinkler went into service in 1919 and took the place of 7 horse-drawn carts.

Commissioner Sullivan, among his numerous duties of street commissioner, also has charge of spraying trees with a view to exterminating the elm beetle and tussock moth. Last year post cards were sent to all persons whose trees had been sprayed by the city the year before asking them to advise the department if they wished the work done again. 296 citizens requested the city to spray 2,557 trees and this was done at a total charge of $1,290. In addition, 4,985 city trees were sprayed, making the total number sprayed 7,542. The total expenditure for this service was $3,192 or, about 40 cents per tree—about 10 cents less than was charged the private citizens for spraying.

Unusually Complete Sewage Purification

The effluent from the Cowley sewage disposal works at Uxbridge in the London, England, metropolitan district, is discharged into a stream used for the London water supply and every endeavor has been made to produce the best practicable effluent. The plant has a capacity for 125,000 gallons of sewage per day, estimated to be the dry weather flow from 5,000 population.

There are three sedimentation tanks with a capacity of one day's dry weather flow, two of which would be in use and one empty when the population is normal, the third being used as a reserve and to permit of cleaning, repairs, etc. The effluent from these tanks is conveyed to a dosing chamber where a siphon discharges it onto two primary filters. Each primary filter is 74 feet in diameter and 5 feet deep and surrounded by 9-inch walls. The bottom is covered with tiles three inches high provided with drainage holes, on which is laid the filtering medium which is composed of granite, clinker, and slag graded from two inches diameter to one inch. The sewage is distributed on the surface of the filters by means of rotary distributors.

The effluent from the primary filter is conveyed to a second dosing chamber and discharged by it onto two secondary filters, the filtering medium of which is graded between 1½ inches and 1 inch. The effluent from the secondary filters flows into two humus tanks. After leaving in these tanks the suspended matter from the filters, the effluent is conveyed onto four sand filters 18 inches deep for final treatment before being ultimately discharged into the river Pinn, a tributary of the Thames. These sand filters are cleaned by forcing wash water upward through them, the water being pumped from a small storage tank by means of a gasoline-driven pump. The sludge from the humus tanks is removed onto drainage beds constructed in the adjacent gravelly soil. The sludge from the sedimentation tanks is discharged into trenches in the land and covered with the excavated material.

From the time the sewage is discharged into the sedimentation tanks until the final effluent reaches the stream, all parts are entirely automatic in action as far as possible and the plant requires little beyond cleaning and removal of sludge. The engineers for this plant were D. Balfour & Son of London. This plant was visited a few weeks ago by members of the Association of Managers of Sewage Disposal Works of England. In exhibiting the plant, Mr. Balfour stated that his firm had constructed 178 similar installations for the government, the aim in each case being to make the plant as perfect and as automatic in its working as possible, so that the man in charge might even remain away for a week and the purification of the sewage continue in a satisfactory manner.

Maintaining Street Car Traffic Over A Fire Hose.

Recently traffic was maintained by the Los Angeles, Calif., street railway cars over a line that was obstructed by a fire hose in service, by the use of a simple expedient that protected the hose and prevented car blockade on both sides of it. Where the hose crossed the track it was passed through openings in a pair of special steel bridges that were set on the track rails and provided inclines over which the street cars, hauled by a 2-ton White truck, passed safely over the hose without injurying it. The bridges were of simple heavy construction, consisting of pieces of rails connected by a center panel bolted to them and making a portable device that can be quickly placed in position and quickly removed whenever required.

The truck shown in the illustration is frequently used for emergency work, which often consists of hauling a derailed street car back on its track. The truck is also equipped with a three section telescope tower, designed to facilitate the repair of overhead wires and is provided with an equipment of blocks, tackle, picks, shovels, crowbars, ropes and the like, making it efficient for general emergency and wrecking work.

Concrete Construction "Kinks"

The "Dixie Highway" recently described a number of "kinks" which had been used by contractors in the construction of concrete roads during 1921, which indicate that American road contractors will never reach the end of their resourcefulness in devising new methods for meeting every new condition or for the securing of greater efficiency under old ones.

In loading trucks or wagons with sand and broken stone aggregate it is common to have a measuring box under a bin of each material and, having discharged into the truck the proper amount of one class of aggregate to drive under the other box and receive the proportionate amount of the other aggregate. One contractor built the two bins upon a single trestle with a driveway under the sand bin only. Only one measuring box was used, which ran on rails fastened on the trestle posts that support the bins. When the desired amount of stone had been discharged into the box, it was readily run on these rails by one man to a position under the sand bin and over the truck, where it received its charge of sand, and both aggregates were then discharged into the truck, which thus neither had to pass through one bin to the other nor to wait while two measuring boxes were being filled.

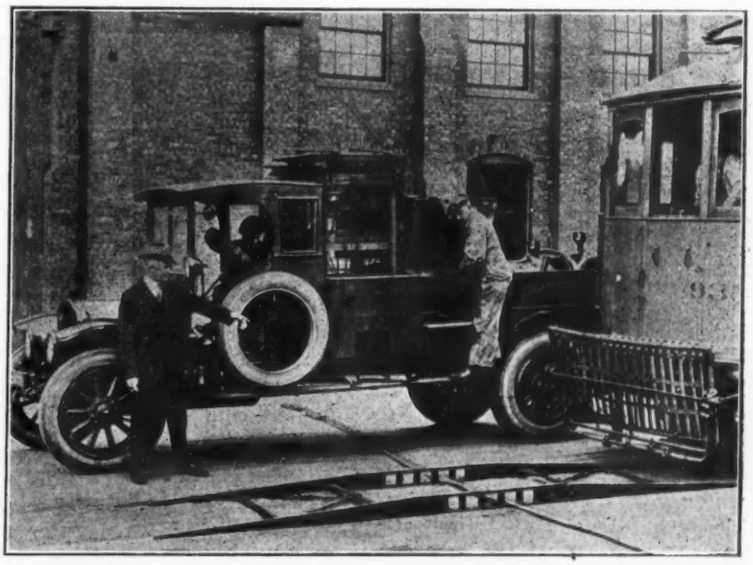
In Collingswood, N. J., a central mixing plant for laying concrete pavement was located against one side of a retail coal elevator. Bins inside the elevator were filled with the aggregates by a coal handling apparatus and discharged them into measuring boxes over the mixer by means of chutes passed through the wall of the elevator house. Cement was taken to the loading platform by a small elevator. The mixer was elevated above the ground and discharged directly into a truck.

Another contractor, being in immediate need of side forms for a concrete road and being unable to obtain fabricated steel ones promptly, managed to get along with wooden ones made as follows: The vertical face was made of 2 by 6-inch timber and the bottom piece of 2 by 3 timber, the two being braced together b ytriangular blocks, three of which were fastened in each 10-foot section, one of the blocks extendng beyond one end of the section to form a splice with the adjoining section. Three holes were bored in the bottom or flange piece of each section and three steel pins bent over at the top were driven through these holes to hold the form in place. A light steel channel or strap was fastened to the top of the vertical plank, forming a running surface for the finishing machines.

Was Sedimentation Basin Necessary?

The U. S. Bureau of Public Health has abstracted a report for the year 1910 of the water works of Rotterdam, Nevertherlands, which contains some rather interesting figures. One of these is the per capita consumption which increased from 19 liters per capita in 1875 to 224 liters in 1893 declining to 163 liters in 1898 to 1907, when there was a sharp decline to 99 liters due to a campaign against waste in which metering played a part.

Perhaps the most remarkable figure given is that for the collection in the sedimentation basin. The water is treated by sedimentation in two basins followed by slow sand filtration. Basin No. 1 was not cleaned between 1890 and the end of 1909, or more than 19 years. At the latter date the water was drawn off and the depth of deposit was found not to exceed 1.1 meter at any point. In the second basin there was a vigorous growth of water plants, but following the cleaning of basins No. 1 the plant growth was much reduced, the absence of the thick clumps of batrachium of former years being especially noticeable.



MOVING CAR OVER BRIDGE THROUGH WHICH HOSE PASSES

Organization of Metropolitan Districts

Report of the sub-committee on sewerage of the American Society for Municipal Improvements, comprising Langdon Pearse, chairman, George G. Earl and C. M. Reppert.

With the increased attention to sanitation and, in particular, the development of pure water supplies and clean waterways, considerable activity has resulted in the formation of various commissions, boards or districts, looking toward the provision of facilities for two or more municipalities acting together. These efforts have come about through the legal difficulty of co-operating without some method of joining responsibilities by organization, and with the knowledge that better development can be had through utilities, such as a water system or sewers, planned to serve a drainage area or district rather than individual towns by political boundaries.

This tendency was early recognized in England through the formation of river boards, such as the Birmingham, Tame and Rea Drainage Board, under whose control is the removal and disposal of sewage of Birmingham and surrounding territory. Such boards in England have been jointly organized under various parliamentary acts for the cleanings of streams to prevent nuisance.

In the United States the tendency was originally toward the formation of commissions organized and empowered by the State to carry out specific work. Among the earlier commissions were the Metropolitan Sewerage Board in Massachusetts, serving Boston and the metropolitan area around, and the Metropolitan Water Board. These two were later consolidated into one board after the major portion of the work had been accomplished. The Water and Sewerage Board has developed largely into an operating organization.

On the other hand, in the West, in Illinois, the formation of sanitary districts received an early start, with the enabling act in 1889 forming the Sanitary District of Chicago, a separate municipal corporation with broader powers than those of the Massachusetts commission, being a separate municipality overlying other municipalities, but with a particular purpose and indefinite life. Further, broader bounding and taxing powers were given than in the East. Other enabling acts have been passed in Illinois and in Indiana. In New Jersey, the formation of the Passaic Valley Sewerage Commission and such joint projects as the Plainfield, North Plainfield and Dunellen Sewerage District, have added to the list.

In the desire to obtain municipal ownership of waterworks in the State of Maine, the water district idea was developed largely through the efforts of Mr. Harvey B. Eaton, an attorney, who has summarized the history and enabling acts very completely in a paper entitled "Maine Water Districts and Appraisals" published in the New England Water Works Association (XIX, 147, 1915).

The Maine water districts resembled the Sanitary District of Chicago, in that they had bonding and taxing powers and were overlying municipalities organized for a specific purpose in the water districts, —that of serving water. A number of districts have been organized in Maine. Elsewhere might be mentioned the Greater Winnipeg Water District and the Metropolitan Water Board of London (England). There are also a number of private water companies supplying groups of towns.

In a report upon the Metropolitan Water and Sewerage Systems made to the Essex Border Utilities Commission, Ontario, Canada (1917), Morris Knowles has covered very broadly the Metropolitan district idea, securing unity of action by (1) annexation, (2) extension of municipal jurisdiction, (3) contracts between municipalities, (4) county administration, (5) private enterprise, (6) metropolitan districts. Various examples are discussed, and the difficulties. The methods in vogue of payment of costs are also discussed, chronologically.

No mention is made in this report of the commissions organized to make engineering reports on metropolitans projects, such as the Metropolitan Sewerage Commission (N. Y. City), Commission on Additional Water Supply (N. Y. Hering-Burr-Freemen), Charles River Dam Commission (Boston) and others. Their field has been a useful one, in most cases paving the way for construction and leading to broader acts for the construction organization.

SCHEMES THAT HAVE BEEN TRIED

In general, it is the purpose of this report to cover largely the districts formed for sewerage or drainage of metropolitan areas, and not the drainage of farm areas. For the purpose of constructing the sewerage system of large metropolitan areas, and the disposal of sewage therefrom, with the increase of population, and the need of more complete methods, various schemes have been tried as outlined. These may be summarized according to the degree of authority given, and appear to fall under three general groups:

1. Commissions or Boards formed by City Councils for the specific purpose of building intercepting sewers largely and practically within the confines of one municipality. These hardly come within the definition of the metropolitan districts serving two or more municipalities, but should be mentioned because of the organization of such Commissions as the Fitchburg Sewer Commission, and the Syracuse Intercepting Sewerage Board, and others.

2. Board or Commissions appointed by elective officers of Cities, County or State, given resources, either limited by specific act or by action of the municipal or Federal bodies governing the municipalities composing the district. Under this classification might be placed such Board as the Metropolitan Water and Sewerage Board, the Passaic Valley Sewerage Commission, the Commission of the District of Columbia and others.

3. The formation of Sanitary Districts which are complete municipalities in themselves, with powers of taxation, with bond issues dependent upon referendum, and with officials appointed by County or State officers. Under this classification come the smaller Sanitary Districts in Illinois, such as those organized at Decatur, Bloomington, the North Shore Sanitary District, and Downers Grove.

4. Sanitary Districts organized as municipalities with complete taxing and bonding powers, without referendum on bonds, with governing officials elected by direct vote of the people residing within the limits of the district. Under this classification comes the Sanitary District of Chicago.

Practically all the districts mentioned and discussed in this report are those lying within the boundaries of one state. The Committee has thought it desirable to call to the attention of those interested the need of some form of organization which will insure co-operation between districts lying in two or more states. With the growth of pollution in streams, and the difficulties in obtaining suitable water supplies such metropolitan difficulties may occur on stream watersheds, both from the water and sewerage standpoint, involving two or more states, as in the case of the Ohio River, for instance, involving Ohio, Kentucky, West Virginia, Pennsylvania, and territory lying in Missouri has to be considered. Such relations under the governmental organization of the United States would appear to require a federal act covering the creation of river or drainage Boards, with powers extending over several states, to coordinate effort and use common policies in matters relating to use of streams for sewage disposal and the taking of water supply therefrom. This would appear to be the next development in a chain of acts which has been gradually formed through the last forty years.

FINANCING

To finance the necessary works, money must be raised. This is usually done by issuing bonds, or by special assessment. Occasionally part of the general taxes is also designated. Operating and maintenance charges, as well as the payments of interest and sinking fund to retire bonds, when issued, are generally met by taxation, or by special assessments and also by rates based upon service.

Where the power to issue bonds is given the amount to be issued is usually fixed, sometimes by definite figures (Fitchburg, Syracuse) but generally in terms of per cent of the valuation of assessed property. In many states this is 5 per cent, an amount fixed by the state constitution. In the Indiana acts, the per cent is fixed at 0.8 of 1 per cent for Indianapolis, and 2 per cent in the general act (1913). In Illinois, the Sanitary District of Chicago has a 3 per cent limit, whereas under the Illinois acts, a per cent limit is set. The maximum rate of interest is also sometimes stated. The maximum rate of interest on bonds is often limited to 5 per cent (Indiana). Although in the case of Indianapolis a 4½ per cent limit was fixed. The retirement of bonds is also provided for 20 year annual installments being common (Illinois, Indiana). In the Essex Border Utilities Act the limit was set at 30 years, whereas at Indianapolis 50 years was allowed.

In the older districts bonds may be issued without referendum for the corporate purpose. In the districts formed more recently, many acts require a referendum on the bonds, as a whole. Where the act specifically limits the amount in dollars, as a rule the act is the result of public agitation demanding relief.

In the case of the Illinois and Indiana districts special assessment has not been used to meet construction in Metropolitan organizations. In the Passaic Valley, however, the cost of construction was assessed or apportioned among the various constituent municipalities roughly in proportion to the service rendered. In the Vancouver sewerage act 30 per cent of the construction cost is to be assessed upon the municipalities in proportion to their land valuations, and the remaining 70 per cent in proportion to the valuation upon lands benefited. But in determining the division of operating costs, assessment is frequently made against the individual municipalities in the district, which in turn is distributed by taxes or service charges (Boston Metropolitan District, Passaic Valley, Miami Conservancy). In Illinois and Indiana, tax levies are made through the usual machinery, to raise the monies to pay interest, operating and maintenance expense, and provide a sinking fund to retire bonds.

In Indiana, for Indianapolis, a levy of two cents on the $100 was allowed, plus a levy for sinking fund and interest. The general Indiana Act provides for 0.25 of 1 per cent.

In Illinois, the Sanitary District has a taxing power of 2/3 of 1 per cent of the assessed valuation. Owing to the scaling of the amount by the County Clerk, a recent amendment has placed a minimum rate of 1.2 mills on the dollar. The general Illinois acts provide in one case for a rate not to exceed ½ of 1 per cent, and in the other for ½ of 1 per cent, although the latter may be doubled by a referendum vote.

In the Miami Conservancy District a levy of 0.3 mill on the dollar is provided for preliminary expenses.

The size of the governing board varies widely, from a minimum of three (Illinois general, 1917) to a maximum of 13 (New Orleans) in the U. S. and 17 (Essex Border) in Canada. Some acts provide for service without pay, others provide pay as high as $7,500 per year.

The limits set on the powers of the board vary. Some acts are very explicit on the terms of advertising contracts, etc., others are not. Ten (10) days is a common limit. Some prescribe thirty-one (31) days. The limit of expenditure without advertising is occasionally fixed, $500.00 being a common figure.

In general, the acts appear to have been effective in providing machinery for necessary work. Occasionally, where a referendum is required, the project has failed by lack of votes to authorize bonds (Bloomington and Normal) or has been delayed by failure to seek authorization of bonds. The limits set by per cents of valuation in some cases have proved inadequate, and in future acts should be chosen with greater care, to provide necessary funds, both by taxation and by bond issue.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans, La.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-19—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3817 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little oRck, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING. 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

GOOD ROADS CONGRESS

The growing demand for wider and roads and stronger bridges has awekened the officers and directors of the American Road Builders' Association to the need for action and the program committee has provided for an exhaustive discussion of the subject at the Twelfth American Good Roads Congress and Thirteenth National Good Roads Show to held in Chicago, Janueary 16 to 20, next.

The elimination of grade crossings will be one of the phases considered. Out of 12,000 persons killed on the highways of the country last year, 7,000 were struck down at grade crossings.

An investigation conducted recently by the Maryland State Roads Commission demonstrated that most highway accidents occur on long stretches of road instead of at the curves and are due to speeding or reckless driving, rater than skidding. Investigation has shown also that one motorist in every three is careless at grade tracks at reckless speed and without taking due notice of approaching trains.

The Pennsylvania and Southern Pacific railroads, especially, have been heavy sufferers from grade crossing accidents. On the Southern Pacific lines alone during tse past three years 1909 motor cars and trucks were wrecked at grade crossings. In 490 cases, or more than 20 per cent, the mitorists deliberately ran into the trains. In 122 instances autos plunged throug the crossing gates. Nine crossing flagmen were struck down.

In 970 cases in which motorists ran in front of the trains 136 persons were killed and 405 were injured. In 490 cases motor cars stalled on the crossing and were demolished. Forty-three cars actually colided with the danger signals.

A total of $4,500,000 was paid out in death claims by American insurance companies for the 12,000 persons killed on the highways last year. In addition to the fatalities there were 1,500,000 non-fatal injuries.

At the good road congress many subjects of importance to highway users will be discussed, including the strengthening of bridges to carry the ever increasing truck loads and a more equitable distribution of taxation for the construction and maintenance of highways. Last year Federal, state and municipal taxes on motor cehicles reached the staggering sum of $316,720,000—equivalent to $34 per car. Governors of states, county commissioners and mayors of cities throughout the country are being asked to appoint delegates to the congress.

The American Road Builders Association has issued very complete data for the information of exhibitors in the Good Roads Show, fully covering the packing, marking, shipping evpressing, trucking, erecting, installation, arrangement of machinery and other exhibits, furniture and decorations for booths, lighting insurance, signs, etc.

Henry W. Wilson has been elected Vice-President and General Manager of Willite-Road Construction Co., of Penn. Hhis company awns the control of the N. J. Willite Paving Co. and the Southern Willite-Paving Co. Large yardages of Willite pavement have been constructed in New Jersey and Pennsylvania this past season and additional work is rapidly being booked throughout the same territory and also in Maryland, Virginia and North Carolina. These companies have no connection with the Willite-Road Co of Mich.

Charles F. Bauer has been elected Vice-President of N. J. Willite-Paving Co. Office will be opened on the completion of the building of the Trust Co. of New Jersey at Bergen and Sip Avenue, Jersey City.

Major J. L. Lee, recently of the Construction Division, Q. M. C. U. S. Army, has been appointed District Manager of Willite Road Construction Co. of Pa. with offices at 611 Brown Bros. Bldg., 4th and Chesnut St. Phila. Pa

ASSOCIATED GENERAL CONTRACTORS

At the Cleveland Convention, Jan. 17, 18 and 19 there will be a Highway Divisional Meeting, Jan. 18, for which the chairman, Stanley D. Moore, Wateill Ia. requests advance notices of subjects proposed for discussion.

The meeting will be divided into two sessions. The morning session will be for introduction and discussion The afternoon session will be devoted to action and resolutions.

The following subjects have already been proposed for discussion; more are invited

1. Freight rates on empty cement sacks.
2. Elimination of tax free bonds and securities.
3. Cement Trade Practice.
4. New lessons learned this year.
5. Classification of Excavation.
6. Free and overhaul limits.
7. Price revision of quantity changes.
8. Responsibility, penalties, and remuneration for delays.
9. Equipment shortcomings and innovations.
10. Provisions for inspection at source.
11. Separation of unit price operations.
12. Allocation of overhead on force account work.

New Catalogs of Interest to City and County Engineers, Superintendents of Water Works, Superintendents of Streets, Contractors and All Engaged in Public Works

If you want any of these Catalogs, write the number on a postal, sign your name and address plainly, and mail it to PUBLIC WORKS, 243 W. 39th St., New York. The Catalogs will be sent to you promptly without charge or obligation.

COLUMBIAN TRUCK EQIUPMENT

245. Columbian Steel Tank Co., 1519 W. South St., Kansas City, Mo. Data sheet No. 59, illustrations of Columbian dump bodies, hand hoists and motor-motive hoists, with descriptions of special features of 5 styles of dump bodies.

FORDSON TRACTORS SPECIALTIES

246. Wehr Company, 533 30th St., Milwaukee, Wis. Leaflet descriptive of the Wehr road grader-cleaner, a road making machine intended for county road patrol work.

PROPER USE OF CEMENT

247. Lehigh Portland Cement Co., Chicago. A vest pocket booklet on the fundamental principles of concrete handling with practical suggestions, directions and sketches concerning materials, mixing, placing, proportion of mixtures and cautions.

SAND

248. Lehigh Portland Cement Co., Chicago. A vest pocket booklet on the importance of sand in the making of concrete and method of testing. Describes the respective properties of coarse and fine sand and the necessity of having clean sand and explains methods and apparatus for making field tests of sand for organic impurities as adopted by many laboratories, engineers and contractors to determine the feasibility of sand for use in concrete.

AIR LIFT PUMPING SYSTEMS

249. Sullivan Machinery Co., Chicago, Ill. 6 x 9, 40 pages, description of methods and apparatus for deep well pumping with many illustrations of installations, diagrams of principal details and convenient tables of required data.

DISPLACEMENT PUMPS

250. Sullivan Machinery Co., Chicago, Ill. Leaflet describing a displacement pump for elevating acids by compressed air in which among other advantages the liquid pumped does not come in contact with any moving part, there is no precipitation or emulisification of the acids being pumped and a wide range of materials, capacity and pressure is afforded.

SULLIVAN ROTATORS

251. Sullivan Machinery Co., Chicago. 6 x 9 in., 32 pages, catalog of all round rock drilling machines or improved type of hammer drill used for block holing, shaft sinking, drifting, stoping, and light tunneling in hard and soft rock, quarries, road grading, sewer trenches, and open cutwork. Complete details illustrations and descriptions and examples of use of machines, weighing 29 to 40 pounds.

KOEHRING PAVERS

260. Koehring Co., Milwaukee, Wis., 7½ x 12½ inches, 16 pages, illustrated, stiff covers. Describes machine for which exceptional speed and durability are claimed. Illustrates five-action mixing principle, measurement of water, and accurate timing, and describes principal features of construuction and operation.

STANDARD FUEL OIL ENGINES

261. The Hadfield-Penfield Steel Co., Bucyrus, Ohio, two 9 x 11 inch catalogs describing and illustrating their Diesel Type Horizontal and Vertical Standard Fuel Oil Engines. The engines are built on the two cycle principle with a cross head which also serves as a pumping piston for furnishing air to clean out and fill the main working cylinder.

The Horizontal Engine is built in three cylinders in three sizes—50, 75 and 100 B.H.P. The latter two sizes being built as Twin Units giving 150 and 200 B.H.P. The Vertical Engine is built in two cylinder sizes—50 and 125 B.H.P. per cylinder and two to six cylinder units.

YUBA RODEBILDER

262. Yuba Mfg. Co., 438 California St., San Francisco, Cal., folder describing tractor with caterpillar tread and single front wheel that developes a 6.000 pound drawbar pull with 40 h.p. pulley rating.

CENTRIFUGAL FIRE PUMPS

263. Dayton-Dowd Co., Quincy, Ill. Lists and illustrates gasoline and turbine driven centrifugal fire pumps with capacities up to 1,500 r.p.m. under a pressure of 100 pounds. Gives photographs of installation and tests of equipment.

TWO-STAGE AIR COMPRESSORS

264. Curtis Pneumatic Machinery Co., St. Louis, Mo. Leaflet describing two-stage compressors with copper intercooler and special fly wheel that is designed in one size only but can be operated at different speeds and thus secure two corresponding capacities.

SEWAGE TREATMENT

265. Dorr Co., engineers, 101 Park Ave., New York City. Bulletin illustrating use of Dorrco screens and method of treatments of sewage and waste waters from municipalities, industrial works and others.

AVERY GOOD ROADS NEWS

266. Avery Co., Peoria, Ill. A periodical issued "in order to spread the propoganda of correct construction and maintenance of dirt roads. Emphasizes the use of the Avery Road-Razer.

CONCRETE EQUIPMENT

267. Miles Mfg. Co., Jackson, Mich. 7 x 10-inch, 60 pages, descriptions and illustrations of simplex continuous concrete mixers and of presses for making concrete and cement block and bricks.

CONCRETE AND MORTAR MACHINES

268. Republic Iron Works, Tecumseh, Mich. Bulletins Republic 10, Monarch, and Republic 6, illustrating sack size concrete and mortar mixer, cement block machines, and super-6 general utility concrete mixer, mounted on wheels.

NORTHERN CRANE

269. Northern Engineering Works, Detroit, Mich. Catalog 28, 6 x 9 inches, 32 pages, listing and describing electric travelling cranes, bridge and gantry cranes, hand power cranes, and all types of pillar and jib cranes, derricks, electric hoists, overhead tracks, air hoists, trolley, air jacks, turntables, transfer tables, and miscellaneous electric pneumatic hand power equipment.

REINFORCED CONCRETE PAVING

270. Thomas Steel Reinforcement Co., 1112 Majestic Bldg., Detroit, Mich. 9 x 6-inch 48-page pamphlet, illustrating construction of pavement with little Hercules reinforcement bar stool and anchored protection for expansion joints.

POINTERS TO PROFIT

271. Acme Motor Truck Co., Cadillac, Mich. 1921 edition, 6½x10 in., 40-page catalog, of 1-ton, 1½-ton, 2½-ton, 3½-ton, and 5-ton chassis and body equipment, including 1921 specifications for Acme model AC 2½-ton special truck, designed to meet the speed and power requirements, for city fire departments, long distance hauling, road building and other special work.

MEMONINEE MOTOR TRUCKS

272. Menominee Motor Truck Co., Clintonville, Wis. General specifications for 1-ton, 1½-ton, and 2-ton trucks of high quality.

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TEXACO SHEET ASPHALT

273. Texas Company, 17 Battery Place, New York City. Small booklet, describing construction of Texaco sheet asphalt pavement, with different kinds of foundations and an open or closed binder course, together with a wearing surface with instructions how to prepare and place the binder and wearing surface, sections of pavement and illustrations of operations and finished work.

CONCRETE HIGHWAY BRIDGES

274. Lehigh Portland Cement Co., Chicago. 6 x 9 in., 13 pages, paper covered, illustrations of smaller types of concrete highway bridges and culverts, discussing the advantages of concrete, principal of construction. Shows many half tones of attractive structurts and gives tables of bearing power of soil and of quantities required by the Wisconsin Highway Commission for bridges up to 24-foot spans. Typical workings drawings of 14-foot spans and of 3 x 4-foot box culverts.

BULK CEMENT

275. Lehigh Portland Cement Co., Chicago. 6 x 9 in., 10 pages, discussing advantages and giving examples of bulk shipment and describing methods of unloading, handling and measuring cement in bulk.

HOYNESITE EXPLOSIVES

276. Hoynesite Explosives Co., general office, 316 National Building, Cleveland. Booklet describing the advantages claimed for Hoynesite explosive used as blast to throw rock, in pellet form as coal powder, as oil well powder, and as special powders made up to requirefents.

CRESCENT SEWER PIPE MOULD

277. Barber & Long Mfg. Co., Kendallville, Ind. Bulletin of sectional all-steel bell end forms both for sewer pipes and culvert pipes of any length, diameter and thickness required.

BULL-DOG BATCH MIXERS

278. Barber & Lang Mfg. Co., Kendallville, Ind. Bulletin 16, illustrating and describing steam driven side loader mixers and gasoline driven power side loader mixer all on trucks with prices and specifications.

TOP-STEWART TRACTORS

279. Top-Stewart Tractor Co., Clintonville, Wis. 7½ x 6¼ in., 32 pages illustrated, bulletin of machine with special traction shoes, with illustrations of its use for building and cleaning irrigation ditches, and road ditches and for hauling trailers, scarifiers, wheel scrapers and gravel wagons in road patrol work. Specifications, pictures and ilustrations of operations, and testimonials.

STEEL JAIL CELLS

280. E. T. Barnum Iron Works, Detroit. Jail Cell catalog 458. 1½ x 8½, 32 pages, illustrated, steel cells and jail fittings and equipment, with several plans for small jails.

ENGBERGS VERTICAL ENGINE

281. Engbergs Electric & Mechanical Works, St. Joseph, Mich. 8½ x 11 inches, 36 pages, illustrated, heavy paper covers, illustrations and descriptions of 1 to 100-h. p. engines that have been furnished in large numbers to municipalities and industrial organizations and for operating compressors, generating sets, pumps, sand and mixers, and for general power purposes.

DIRECT CURRENT GENERATING SETS

282. Engbergs Electric & Mechanical Works, St. Joseph, Mich., 8½ x 11-inch, 32 page, illustrated, heavy embossed paper cover, catalog 103 of Direct Current Generating Sets of 1 to 50 kw.

CONVEYORS

283. Chicago Automatic Conveyor Co., Lumber Exchange Bldg., Chicago. Illustrated bulletin of portable, wheeled, extended, fixed and semi-portable belt and bucket conveyors for handling and transporting materials and loading and unloading cars and trucks.

NORTHERN ROTARY PUMP

284. Northern Fire Apparatus Co., Minneapolis, Minn. Leaflet describing chief types of pumps with capacities ranging from 26 to 1,000 gallons per minute at pressures of 50 to 300 lbs., furnished for electric, steam or oil drive, belt gear or straight line flexible pumping connection.

PUMPING MACHINERY

285. Advance Pump & Compressor Co., Battle Creek, Mich. Bulletin 201, 6 x 9 inches, illustrated. Bulletins 201-220 inclusive in adjustable stiff paper covers, describing duplex steam pumps, power pumps, and centrifugal pumps designed with open impellers for a wide range of service.

WILLITE ARMOUR PLATE ROADS

286. Willite Road Construction Company of New York, 51 Chambers St., New York City. Booklet describing Willite process for paving roads with asphaltic binder, containing metallic sulphite, designed to preclude the necessity of special draining of mineral aggregate to insure stability. Illustrated by views and descriptions of roads under construction.

DUFF GENUINE BARRETT JACKS

287. Duff Mfg. Co., Pittsburgh. Folder 803, illustrates and lists principal types of automatic lowering jacks, ball bearing screw jacks, traversing telescopes, screw jacks, motor truck jacks and pipe forcing jacks.

DUFF BANTAM TRENCH BRACES

288. H. W. Clark Co., Mattoon, Ill., Folder describing types of braces with screw adjustments to lengths of from 16 to 60 inches, also Duff Screw Fittings for timber bracing.

WATER WORKS EQUIPMENT MATERIAL AND SUPPLIES

289. H. W. Clarke Co., Mattoon, Ill. Catalog 20, adjustable board covers with fastenings for Bulletins A and AA, illustrating various types and sizes of cast iron meter boxes, forms and fittings for concrete and masonry meter boxes. The whole Catalog 20 will contain 9 bulletins, of which the remaining 7 will be sent on application, as published.

KOEHRING COMPANY, MILWAUKEE, WIS.

290. Leaflet describing construction 18-foot pavement at rate of 536.8 linear feet in 10 hours, using a Koehring Aggregate Bin, No. 21 and mixer. With a total force of 53 men.

QUALITY TANK BODIES AND HOISTS

291. Heil Company, Milwaukee, Wis. Catalogs 120 and 120A, bound in adjustable heavy paper covers, illustrate and describe combination dump bodies with extended platforms, asphalt bodies, garbage bodies, lumber and coal bodies, high lift dumping equipment, gravity tilting dumps and hydrohoists.

VALVES

291. Atlas Valve Co., 282 South St., Newark, N. J., Catalog No. 21, 3½ x 6¼ inches, 20 pages, descriptions and prices of Atlas, Ideal and Victory Reducing Valves, Pump Governors, Pressure Regulators, Hot Water Tank Regulators, Control Valves and Damper Regulators. Vacuum, float and balance valves and fittings.